(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 968 885 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
05.01.2000 Bulletin 2000/01

(51) Int. Cl.[7]: **B60R 16/02**

(21) Application number: **99201875.4**

(22) Date of filing: **14.06.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **30.06.1998 GB 9814082**

(71) Applicants:
, Cummins Engine Company, Ltd.
Darlington, County Durham DL1 4PW (GB)
, Iveco (UK) Ltd.
Watford, Hertfordshire WD1 1SR (GB)
, NEW HOLLAND U.K. LIMITED
Basildon, Essex SS14 3AD (GB)

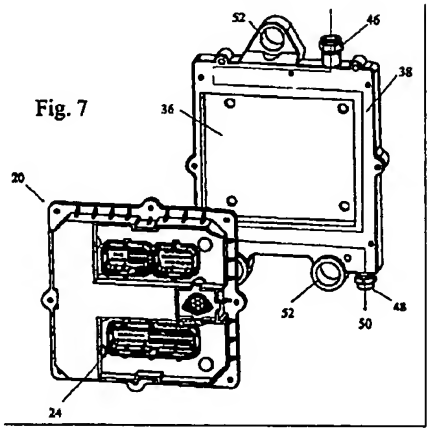
(72) Inventors:
, Clamp, Andrew
Co Durham DL1 3TB (GB)
, Purcell, John J.
Marlow, Buckinghamshire SL7 1QW (GB)

(74) Representative:
Vandenbroucke, Alberic et al
New Holland Belgium NV.
Patent Department
Leon Claeysstraat, 3A
8210 Zedelgem (BE)

(54) Cooling an engine control unit

(57) A chill plate 30 is described for cooling an electronic control unit (ECU) 20 of an engine. The chill plate 30 comprises a housing 32 having a flat front face onto which the ECU 20 may be mounted, formed with a central pocket 36 for accommodating any components 28 protruding from the rear face of the ECU. The housing also includes flow conduits 40 through which fuel may flow around at least part of the periphery of the central pocket 36 to transfer heat to the fuel from the regions of the front face 38 surrounding the pocket 36.

Fig. 7



EP 0 968 885 A2

Description

The present invention relates to the cooling of an electronic control unit (ECU) of an engine, in particular a diesel engine.

It is necessary in vehicles that operate in a hot and hostile environment to take special steps to cool the engine electronic control unit, because electronic components may malfunction if they are overheated. Additionally, the heat generated by the ECU will shorten the life of the ECU if not transferred away.

It has previously been proposed to provide a heat exchanger (commonly called a chill plate) for supporting and cooling an ECU. The chill plate comprises a coolant chamber which, in use, is connected in a supply line through which passes fuel flowing from a fuel reservoir to the engine. The chill plate serves to cool the ECU module by transferring heat to the fuel supplied to the engine. The known chill plates, however, have the disadvantage that they can only be used with ECU's having a flat heat sink of conductive material to which the heat generating electronic components are attached.

It is an object of the present invention to provide a chill plate that can be used with different types of ECU's, including ECU's having components that protrude beyond the surface of a flat heat sink to be cooled. Additionally, this design can be incorporated directly into the ECU housing if appropriate.

In accordance with a first aspect of the present invention, there is provided a chill plate for cooling an electronic control unit (ECU) of an engine, comprising a housing having a flat front face onto which the ECU may be mounted, formed with a central pocket for accommodating any components protruding from the rear face of the ECU and flow conduits within the housing through which fuel may flow around at least part of the periphery of the central pocket to transfer heat to the fuel from the regions of the front face surrounding the pocket.

In order to allow the chill plate to be mounted directly on an engine, the housing is preferably formed with mounting bosses for receiving shock and vibration absorbing rubber bushes.

The housing may conveniently be formed of a metal casting defining an open channel surrounding three sides of the central pocket, and a cover plate for closing the open channel to constitute the fuel flow conduits. The cover plate is preferably welded to the metal casting.

In order to improve the thermal efficiency of the chill plate, the open channel may comprise one or more partitions such that the fuel in the flow conduits is constrained to follow a convoluted path.

Conventionally, an ECU has a metal backing plate with the result that when the ECU is fitted to the chill plate there will be two layers of metal between the liquid coolant and the circuit components to be cooled. In order to improve on this arrangement, it is possible to dispense with the backing plate of the ECU and instead to form the chill plate as part of the ECU housing.

Hence, in accordance with a second aspect of the invention, there is provided an electronic control unit (ECU) for an engine having a rear face and components projecting beyond the rim of the rear face and a plate mounted on the ECU in sealing engagement with the rim of the rear face to define in combination with the rear face a chamber for circulation of fuel for cooling the ECU, wherein the chamber has a central pocket that accommodates the components protruding from the rear face of the ECU and that is surrounded at least over part of its periphery by a flow conduit through which fuel may flow to transfer heat to the fuel from

regions of the rear face of the ECU surrounding the central pocket.

Thus, for high volume applications, all of the features of the invention can be incorporated into the ECU housing instead of requiring a separate housing.

The invention will now be described further, by way of example, with reference to the accompanying drawings, in which :

Figure 1 is an exploded front view of a chill plate of the invention;

Figure 2 is an exploded rear view of the chill plate of Figure 1;

Figure 3 is a perspective rear view of a first type of ECU that may be mounted in the chill plate of Figures 1 and 2;

Figures 4 and 5 are front and rear views, respectively of a second type of ECU that may be mounted on the chill plate of Figures 1 and 2;

Figure 6 is an exploded vertical central section through the chill plate of Figures 1 and 2 and an ECU of the second type;

Figure 7 is an exploded perspective view of the chill plate of Figures 1 and 2 and an ECU of the second type; and

Figures 8 and 9 are respectively front and rear exploded views of an embodiment of the invention in which the chill plate is integrated into the housing of the ECU unit.

Figure 3 shows a prior art type of ECU 10 that is currently available and in use in engine management systems. This ECU 10 presents no particular problem as it has a flat rear face 12 that needs to be cooled around its periphery. Such an ECU can be cooled using a flat chill plate, as already known in the prior art.

Figures 4 and 5 on the other hand show a different type of ECU 20 that is also currently in use and differs from that of Figure 3. On its front face, the ECU 20 has various electrical connection terminals 22, 24. On its rear face, the ECU 20 has a surface 26 that needs to be cooled and a box 28 that protrudes from that surface. The parts of the rear surface 26 that need to be cooled are located partly circumferentially around the box 28 and it will be clear that such an ECU cannot be cooled using a flat chill plate as the protruding box 28 would prevent the parts of the rear surface 26 that need to be cooled from contacting the chill plate.

To mitigate this problem and allow the same chill plate to be used with types of ECU's described above, the invention provides a chill plate 30 that is shown in Figures 1 and 2.

The chill plate 30 is formed of two parts that are welded to each other, namely an aluminium casting 32 and a cover plate 34. The casting defines a pocket 36 recessed into the flat front face 38 of the chill plate, which pocket is surrounded on three sides by a channel 40 of U-shaped cross section. When the cover plate 34 is welded or otherwise affixed to the channel 40 in fluid sealing arrangement, flow conduits are formed for fuel that enters the chill plate 30 through a fuel inlet 46 and leaves through a fuel outlet 48. Two partition walls 42, 44 are cast

into the upper and lower sides of the channel 40, respectively, to constrain the fuel to follow a convoluted flow path through the flow conduit to increase residence time and the effective heat transfer from the electronic components.

In use, as may be seen from the section of Figure 6 and the exploded perspective view of Figure 7, the ECU 20 of Figures 3 and 4 can be mounted on the chill plate because its protruding box 28 can be accommodated in the pocket 36. The chill plate is connected in series in the pipe leading from the fuel tank to the fuel injection system of the engine. The fuel follows the path shown by the arrow 50 in Figure 7. In particular, the fuel enters from the inlet 46, traverses the upper side of the channel 40 twice, descends along the vertical side and traverses the lower side of the channel 40 twice before leaving through the outlet 48. In the process, the fuel extracts heat from the periphery of the front surface 38 of the chill plate 30 which is in thermal contact with the surface 26 of the ECU 20 that needs to be cooled.

The chill plate 30 is intended for mounting directly on the engine. To reduce transmission of engine vibrations to the ECU, the chill plate has three engine mounting bosses 52 that are designed to receive rubber bushes 54 (Figure 6) which are positioned between the bosses 52 and mounting screws which attach to the engine receiving the ECU 20. These bushes absorb shocks and vibrations and also provide thermal isolation between the chill plate 30 and the engine mounts.

It will be clear that the chill plate 30 can equally well accept an ECU of the type shown in Figure 3 that has no protrusions that inhibit the surface to be cooled from being brought into thermal contact with the cooling surface of the chill plate 30.

It is possible in high volume applications to integrate the chill plate and the ECU, such an embodiment of the invention being shown in the exploded views of Figures 8 and 9. Such an arrangement eliminates the need for the cover 34 and the need to have a fluid sealed joint between the cover 34 and the chill plate 30. It is believed that the construction of this embodiment of the invention will be self-evident to the person skilled in the art and to emphasize the similarity, components serving a like function have been allocated like reference numerals but with an addition of a prime to each numeral.

As with the ECU 20 shown in Figures 4 and 5, the ECU 20' of Figures 8 and 9 has electrical connectors 22' on its front face and a box 28' containing electrical components projecting from its rear face 26'. A plate 30' formed as a casting of aluminium or other heat conductive material is mounted by means of screws 60 directly onto the rear face 26' of the ECU 20' and is sealed against it by means of a resilient gasket or rubber ring 62 received in a continuous perimeter groove in the plate 30'. When the plate 30' is assembled to the ECU 20', it defines a sealed cooling chamber having a central pocket constituted by the box 28'. The region of the chamber surrounding the box 28' is divided by a partition wall 44' formed as part of the casting of the plate 30' into a convoluted flow path like the path shown in Figure 2 that surrounds and cools the periphery of the central pocket. Fuel enters and leaves the flow path through connectors 46' and 48'.

The seal 62 prevents fuel from leaking out of the cooling chamber but it is not necessary to take any steps to prevent fuel from reaching the space between the central box 28' and the plate 30'. As the maximum depth of the box 28' is selected to closely fit the facing side of the plate 30', there will be only a small leakage from the convoluted fuel flow path which will not detract significantly from the cooling of the peripheral regions of the ECU 20'.

The plate 30' can once again be used to mount the ECU 20' to an engine and to this end it is

provided with bosses 52' for receiving shock absorbing mounting bushes.

Claims

1. A chill plate (30) for cooling an electronic control unit (ECU) of an engine, comprising a housing having a flat front face (38) onto which the ECU may be mounted, and

characterized in that the housing is formed with a central pocket (36) for accommodating any components (28) protruding from the rear face (26) of the ECU; the chill plate (30) further comprising flow conduits (40) within the housing through which fuel may flow around at least part of the periphery of the central pocket (36) to transfer heat to the fuel from the regions of the front face (38) surrounding the pocket (36).

2. A chill plate according to claim 1, characterized in that the housing is formed with mounting bosses (52) for receiving shock and vibration absorbing rubber bushes (54), to allow the chill plate (30) to be mounted directly on an engine.

3. A chill plate according to claim 1 or 2, characterized in that the housing is formed of a metal casting defining an open channel (40) surrounding three sides of the central pocket (36), and a cover plate (34) for closing the open channel (40) to constitute the fuel flow conduits.

4. A chill plate according to claim 3, characterized in that the cover plate (34) is welded to the metal casting.

5. A chill plate according to claim 3 or 4, characterized in that the open channel (40) comprises one or more partitions (42, 44) such that the fuel in the flow conduits is constrained to follow a convoluted path.

6. A chill plate according to any of the preceding claims, characterized in that the chill plate (30) forms part of the ECU housing.

7. An electronic control unit (ECU) (20') for an engine having a rear face (26') and components (28') projecting beyond the rim of the rear face (26'), and

characterized in that a plate (30') is mounted on the ECU (20') in sealing engagement with the rim of the rear face (26') to define in combination with the rear face (26') a chamber for circulation of fuel for cooling the ECU (20'), the chamber having a central pocket (28') which accommodates the components protruding from the rear face (26') of the ECU (20') and which is surrounded at least over part of its periphery by a flow conduit through which fuel may flow to transfer heat to the fuel from regions of the rear face (26') of the ECU (20') surrounding the central pocket (28').

8. An electronic control unit according to claim 7, characterized in that the plate (30') is formed as a metal casting with at least one raised partition wall (44') which divides the regions of the chamber surrounding the central pocket (28') into a convoluted flow conduit.

9. An electronic control unit according to claim 7 or 8 characterized in that a bottom floor of

the central pocket (28') extends closely adjacent the plate (30') to constrain the fuel to flow in a path around at least a part of the periphery of said central pocket (28').

10. An electronic control unit according to claims 7 to 9, characterized in that a continuous seal element (62) extends around the periphery of the central pocket (28') for sealing fuel in said chamber.

11. An electronic control unit according to any of the claims 7 to 10, characterized in that the ECU (20') is releasably fastened to the plate (30') by means of a plurality of screws (60).

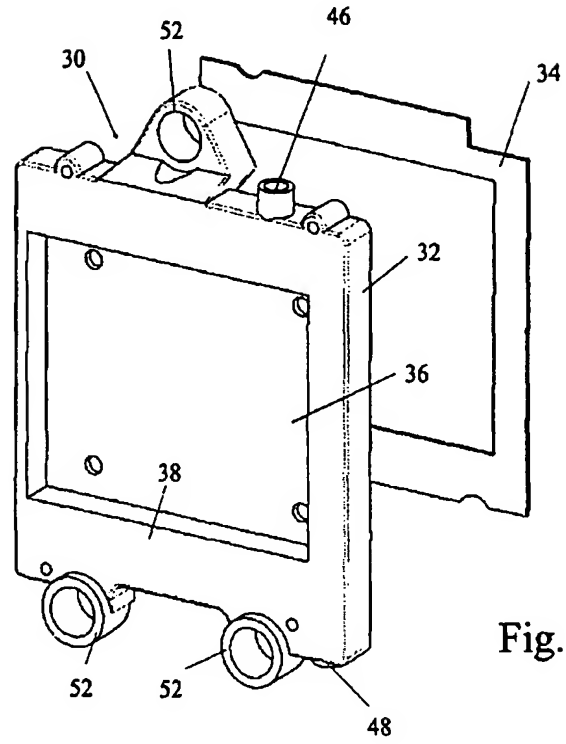


Fig. 1

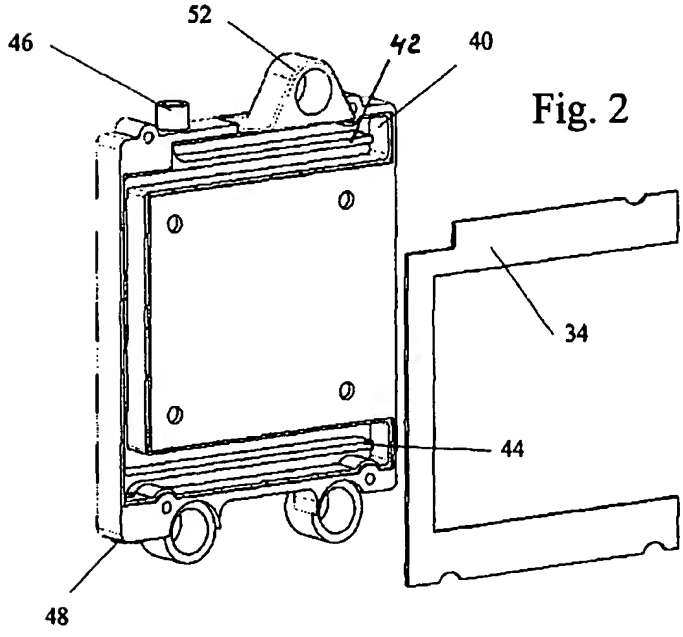


Fig. 2

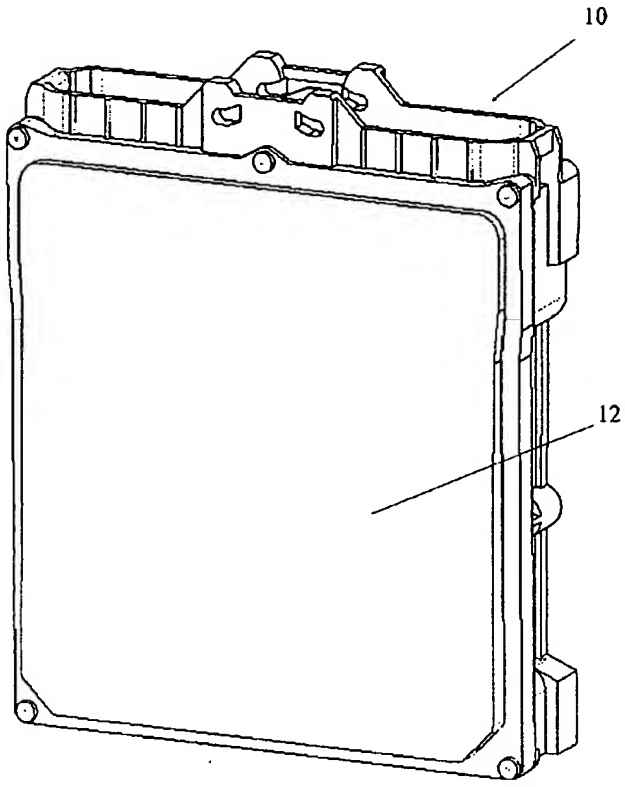


Fig. 3

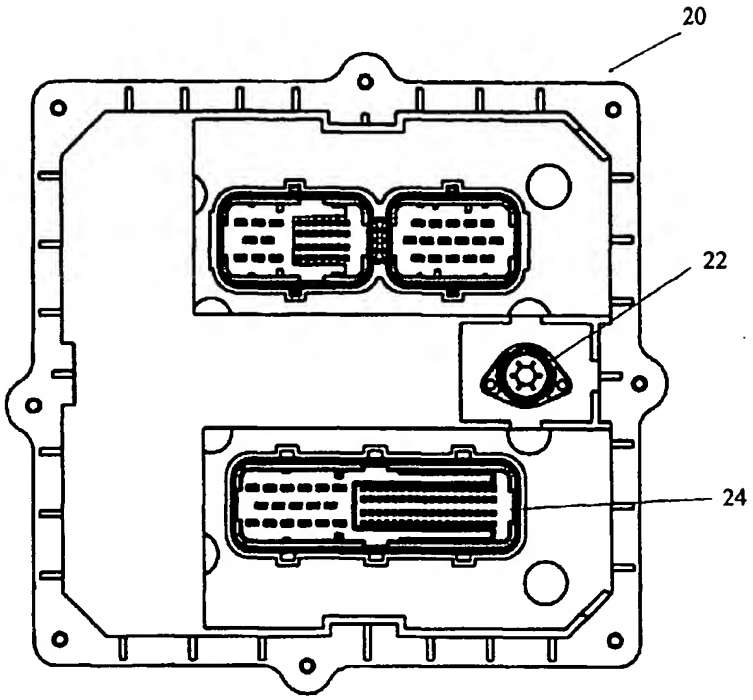


Fig. 4

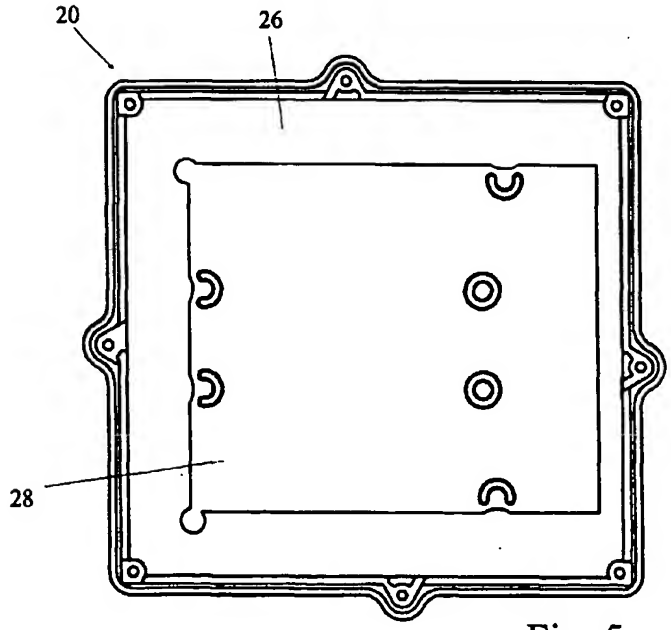


Fig. 5

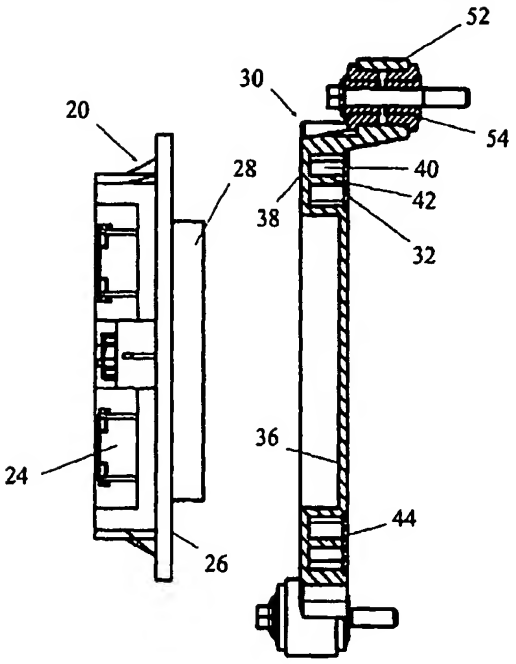


Fig. 6

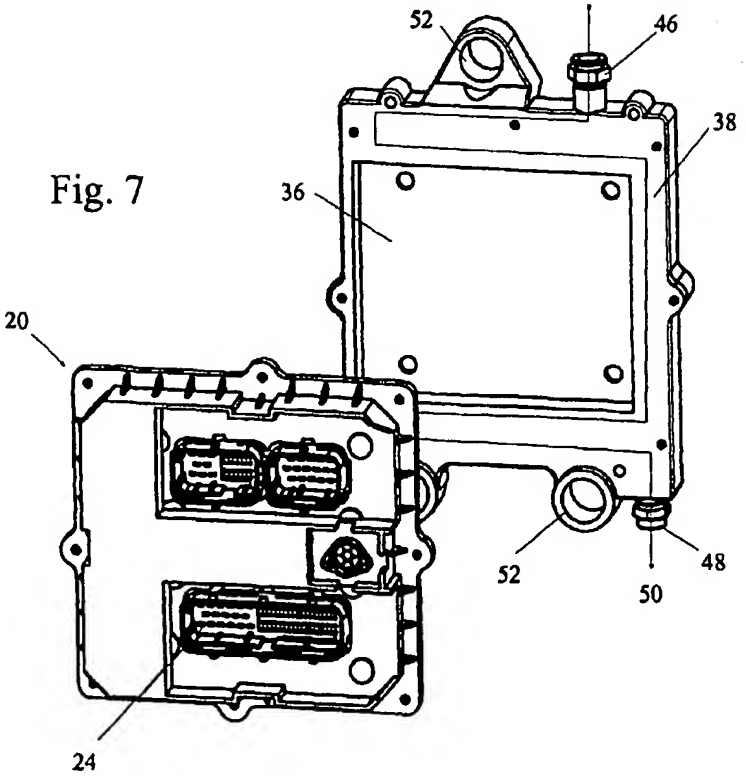


Fig. 7

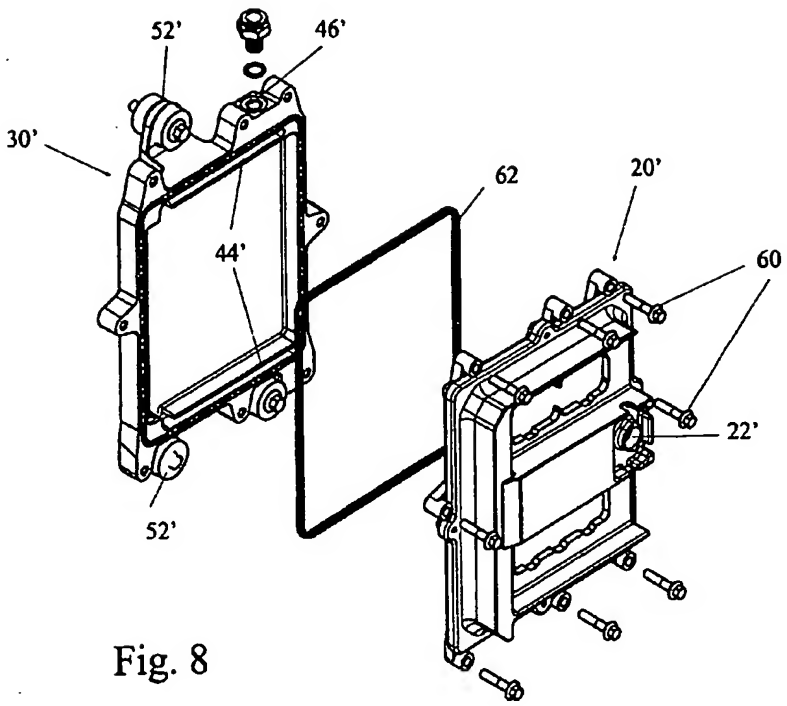


Fig. 8

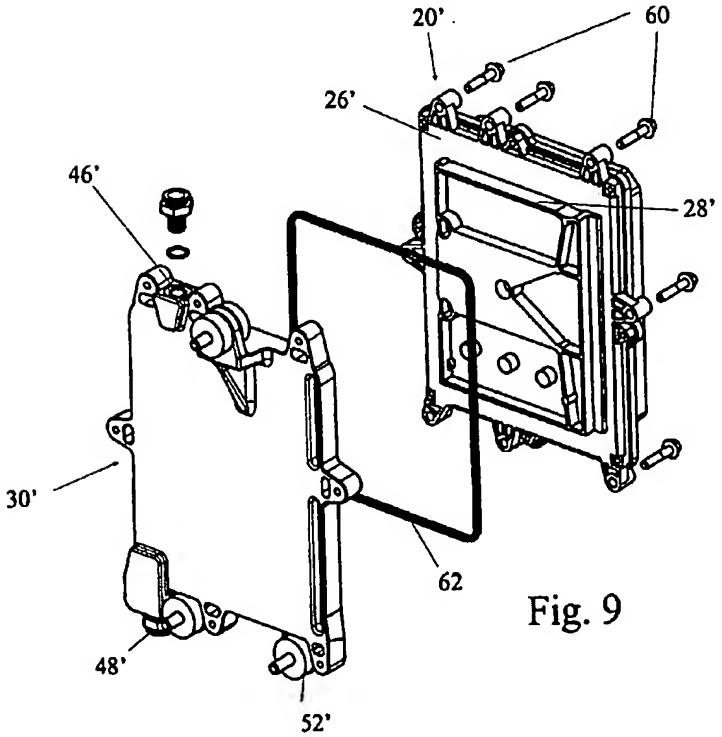


Fig. 9